AUDIOCALC EC9056-AF

Financial version 1.09 / September 1994

User manual Supplement

FONDATION CENTRE LOUIS-HÉBERT
Research and development to serve the person with a visual deficiency

This document describes the financial and statistical functions available with the extended version of the AUDIOCALC scientific calculator specifically designed to respond to the needs of people with a visual deficiency.

Important notice - *Before consulting this document, the user must first be aquainted with the content of the user manual EC9056. In some cases, this version modifies the functions of the original scientific version and may affect the content of the user manual. For information about these modifications, refer to sections "Mode setting" and "Scientific mode" of this document.*

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Important

When the **AUDIOCALC** calculator EC9056-AF is in scientific mode, all the functions are exactly the same as the EC9056 standard scientific version except for functions ***[Memorize]*** et ***[Recall].*** These two functions must be entered with two numbers (00 to 29) instead of one (0 à 9) when editing memories. It is important to be familiar with the content of the user manual before reading the User manual supplement. To verify if your calculator is in scientific mode, enter the following sequence: [0] [F] [Config] [5].

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Mode setting

The extended version of the **AUDIOCALC** calculator offers the three following modes of calculation:

- scientific;
- financial;
- statistical.

To configure your calculator in the desired mode, use one of the following sequences:

- scientific mode: [0] [F] [Config] [5]
- financial mode: [1] [F] [Config] [5]
- statistical mode: [2] [F] [Config] [5]

Available memories

The standard scientific version of the **AUDIOCALC** calculator contains 10 memories. In this version, 30 memories are available. So, when you refer to the memories' section of the user manual EC9056, be aware that the number of available memories has now been changed from 10 to 30.

Moreover, in the standard scientific version, the memories #7 to #9 were used to store telephone numbers, and the content of these memories could, on user request, be displayed and spoken by the calculator. In this version, memories #25 and #29 are used for this purpose.

To identify the memory you wish to retrieve, now use two numbers.

- Example - To store the value 25 in memory #8, enters the following operations:

[2] [5]
[STO] [0] [8]

Scientific mode

Configuration

To configure your calculator in scientific mode, just press the following keys:

[0] [F] [Config] [5].

NOTE: The amount of available memories and the access code to these memories are different in this new version. For additional informations, refer to the previous chapter.

Financial mode

Configuration

To configure your calculator in financial mode, just press the following keys:

[1] [F] [Config] [5].

NOTE: For additional informations on the basic functions of the **AUDIOCALC** such as alarms, help, volume control, etc., refer to the user manual.

Financial problems

This guidebook relates to financial problems with constant cash flow.

Conventions

In a financial transaction, money invested is a negative amount because, to the investor's point of view, the money involved represents a payment. So, the cash flow paid by the one who is the lender is negative and the deposits made by the client are considered positive.

User procedures

Your **AUDIOCALC** calculator has nine functions which allow the user to solve financial problems. Two functions are used to set the basic parameters and two others functions to convert nominal rate to effective interest rate. The five remaining functions are reserved to define the necessary variables.

Basic parameters

The basic parameters are as follows:

number of periods per year (P/Y)	[F] [P/Y] (position 6,1);
cash flow period: beginning or end of period mode (BEG/END)	[F][BEG/END](position 7,2).

Your calculator defines these two parameters automatically. The default value of the number of periods per year(P/Y) is 12 and the cash flow period is defaulted in End of period mode. So, each time that the calculator is reinitialized or when the [F] [Clr all] function is executed by the user, these parameters are automatically reinitialized. In cases where you have to modify these parameters, the modifications should be done before starting an operation. For example, suppose the number of periods per year is 4, you must enter the following digits before starting your financial operations:

4 [F] [P/Y] (position 6,1).

Also, suppose the cash flows take place at the beginning of a period, you must then press the following keys:

[F] [BEG/END] (position 7,2).

Remember, to alternate between the end or the beginning of a period, just repeat the sequence. The **AUDIOCALC** calculator displays the selected mode each time you use the sequence.

To solve a financial problem with your **AUDIOCALC** calculator, all cash flows have to be at the beginning or at the end of a period. If those cash flows are due at the same period, they are cumulated. For example, a negative cash flow of - $250.00 and a positive cash flow of $600.00 taking place at the same period will be calculated as a cash flow of $350.00 ($600-$250=$350). A financial transaction must have at least one positive and one negative cash flow.

Relative functions to interest rate conversion

Relative functions to convert interest rates are as follows:

nominal interest rate(NI)	[F] [NI] (position 6,3);
effective interest rate(EI)	[F] [EI] (position 7,3).

Note the [F] function [P/Y] (position 6,1) is also used to convert interest rates. These functions are used to define, recall, calculate and convert interest rates. When you define a new value in the nominal interest rate memory(NI), the value is displayed and registered in the corresponding memory but it is not expressed. If you convert a nominal interest rate to effective interest rate, the result is displayed and stored in the corresponding memory but it is not expressed. For example, to convert the nominal interest rate of 6% to effective interest rate assuming the number of periods per year is 3:

Commands	**Display**	**Remarks**
[6] [F] [NI] (position 6,3)	6.00	Enters nominal interest rate;
[3] [F] [P/Y] (position 6,1)	3.00	Changes the basic parameters: number of periods per year;
[F] [EI] (position 7,3)	6.12	Converts nominal interest rate to effective interest rate and registers in the corresponding memory.

Relative functions to variables

To perform financial calculations with constant cash flows, the next 5 variables are used:

total number of payment periods(N)	[F] [N] (position 5,1);
annual interest rate(I/Y)	[F] [I/Y] (position 5,3);
payment (PMT)	[F] [PMT] (position 7,1);
present value(PV)	[F] [PV] (position 5,2);
future value(FV)	[F] [FV] (position 6,2).

The relative functions to variables are used to define, recall or calculate values. When you define a new value for one of these variables, this value is stored in the corresponding memory but is not expressed by the calculator. Once the values are registered in your calculator, you can modify them, one by one, without reentering the values of the other variables. To verify the stored values in memories, press on [RCL] key along with the desired function. For example, to verify the registered value in the annual interest rate memory(I/Y), enter the following sequence: [RCL] [F] [I/Y] (position 5,3) and the calculator will express the content of memory. Even if you recall these values, the content of memory is not modified.

Either one of the 5 values can be calculated if the 4 other values are known. But, it is possible that one of the following value be equal to zero: present value(PV), payment(PMT), future value(FV). When you calculate a variable, the result is displayed, expressed and automatically registered in the corresponding memory.

Note that if you use a function without having previously registered the value or made a mathematical operation, the calculator presumes that you wish to calculate. It will automatically calculate this new command and will express the result. If the values of the four other variables are not all defined, the requested function cannot complete the calculation and the "Error" message is expressed. If the registered variable is the result of a mathematical operation, the user must press on [=] key (position 7,4) before calling the function.

Before starting a new calculation, press the following sequence: [F] [Clr all] (position 2,4). This will reset all memories to zero and automatically reinitialize the basic parameters. Note that when you configure your **AUDIOCALC** calculator in financial mode, the memories and parameters are affected the same way.

Financial computation on constant cash flows

To perform financial computations on constant cash flows with your calculator, the following basic conditions must be maintained:

the amount of each payment must be identical;
payments must be due at regular periods;
period of payment must coincide with the compounded period and if it is not so, you must convert the interest rate (refer to interest rate conversion section);
there must be at least a positive and a negative cash flow.

Example 1 - Loan to purchase a car

You wish to finance the purchase of your new car with a 3 year loan at 10.5% annual interest rate and compounded monthly. The total cost is $15,000. and your down payment is $2000.

1st case: Suppose that your payments start one month after the purchase of your car, which means at the end of the first period. How much will your monthly payment be? For reading ease, the registered figures are presented simply (without brackets).

Commands	Display	Remarks
[F] [Clr all] (position 2,4)	0.00	Sets to zero all registered calculations and reinitializes the basic parameters.
3 [X] 12 [=] (position 7,4)	36.00	Calculates the total number of periods.
[F] [N] (position 5,1)	36.00	Enters the total number of periods.
10.5 [F] [I/Y] (position 5,3)	10.50	Enters the annual interest rate.
15000[-]2000 [=] (position 7,4)	13000.00	Calculates the total amount borrowed: the present value.

[F] [PV] (position 5,2)	13000.00	Enters the amount borrowed: the present value.
0 [F] [FV] (position 6,2)	0.00	Enters the balance due at the end of 3 years, the future value.
[F] [PMT] (position 7,1)	- $422.53	Calculates and displays the amount of monthly payment. The minus sign shows that it is a disbursement instead of a gain.

2nd case: You wish to reimburse $400.00 monthly payments which means $22.53 less each month. How much your interest rate will be to maintain such payments?

Commands	**Display**	**Remarks**
[+] 22.53 [=] (position 7,4)	- 400.00	Decreases payment amount.
[F] [PMT] (position 7,1)	- 400.00	Enters new payment.
[F] [I/Y] (position 5,3)	6.76	Calculates and displays the corresponding annual interest rate.

3rd case: The interest rate is at 10.5% and you wish to make monthly payments of $410.00. What is the maximum amount to be available for purchase if you put $2000.00 down payment?

Commands	Display	Remarks
10.5 [F] [I/Y] (position 5,3)	10.50	Enters annual interest rate.
410 [+/-][F][PMT](position 7,1)	- 410.00	Enters payment amount.
[F] [PV] (position 5,2)	12614.44	Calculates and displays the amount to finance: the present value.
[+]2000.00 [=] (position 7,4)	14614.44	Adds down payment and calculates the total amount available.

Example 2 - Home purchase with mortgage

The annual interest rate is at 11.5% and your down payment is $10,000.00. You consider that the maximum monthly payment you can afford is $2000.00.

Query: With a 20-year mortgage, what is the maximum price you can afford for a house?

Command	Display	Remarks
20 [X] 12 [=] (position 7,4)	240.00	Calculates the term of the mortgage: total number of periods.
[F] [N] (position 5,1)	240.00	Enters the total number of periods.

11.5 [F] [I/Y] (position 5,3)	11.50	Enters the annual interest rate.
0 [F] [FV] (position 6,2)	0.00	Enters the balance due at the end of period: the future value.
2000 [+/-] [F] [PMT] (position 7,1)	- $2000.00	Enters monthly payment amount.
[F] [PV] (position 5,2)	187541.68	Calculates the loan you can afford.
[+] 10000 [=] (position 7,4)	197541.68	Adds your down payment and calculates the total purchase.

Example 3 - Mortgage with a balloon payment

You took a $55,000. loan on a 25 year mortgage at 12.5% interest rate to buy a summer cottage.

Query: You plan to sell the cottage in 4 years and reimburse the remaining balance on the mortgage. What would your balloon payment be?

First step - Calculation of payments amount on a 25 year term

Command	**Display**	**Remarks**
25 [X] 12 [=] (position 7,4)	300.00	Calculates the total number of periods.
[F] [N] (position 5,1)	300.00	Enters the mortgage term: the total number of periods.

55000 [F] [PV] (position 5,2)	55000.00	Enters the initial loan amount: the present value.
12.5 [F] [I/Y] (position 5,3)	12.50	Enters the annual interest rate.
0 [F] [FV] (position 6,2)	0.00	Enters the balance due at the end of period: the future value.
[F] [PMT] (position 7,1)	- 599.69	Calculates and displays the monthly payment.

Second step - Calculation of the balance due at the end of 4 years

Monthly payment is made at the end of each month, so the last monthly payment will be cumulate with the future value to calculates the balloon payment.

Commands	**Display**	**Remarks**
48 [F] [N] (position 5,1)	48.00	Enters the total number of periods on the mortgage.
[F] [FV] (position 6,2)	- 53343.28	Calculates the balance due of the loan in 4 years.
[+][RCL][F][PMT](position 7,1)	- 599.69	Recalls the value of monthly payment.
[=] (position 7,4)	- 53942.98	Calculates and displays the total of the last payment.

Interest rate conversions

The nominal interest rate is the periodic rate multiply by the total number of periods per year. This is the rate regularly used in personal loan or mortgage. The effective interest rate is the annual rate considering the principle of compound interest. This is the rate regularly used in calculation for investment.

Example - Comparing investments

You wish to start investing and you have three possible choices. A offers 5.6% annual interest rate compounded quarterly, B offers 5.65% annual interest rate compounded monthly and C offers 5.63% annual interest rate compounded 360 times a year. Which one of these possibilities is the best investment?

Possibility A:

Commands	**Display**	**Remarks**
5.6 [F] [NI] (position 6,3)	5.60	Enters nominal interest rate.
4 [F] [P/Y] (position 6,1)	4.00	Enters the number of periods per year.
[F] [EI] (position 7,3)	5.72	Calculates and displays the effective interest rate.

Possibility B:

Commands	**Display**	**Remarks**
5.65 [F] [NI] (position 6,3)	5.65	Enters the nominal interest rate.
12 [F] [P/Y] (position 6,1)	12.00	Enters number of periods per year.
[F] [EI] (position 7,3)	5.80	Calculates and displays the effective interest rate.

Possibility C:

Commands	**Display**	**Remarks**
5.63 [F] [NI] (position 6,3)	5.63	Enters the nominal interest rate.
360 [F] [P/Y] (position 6,1)	360.00	Enters number of periods per year.
[F] [EI] (position 7,3)	5.79	Calculates and displays the effective interest rate.

Possibility B offers the best rate.

Different compounding and payment periods

For calculations with constant cash flows, compounding periods and payment periods are blended. Therefore, some accounts, deposits or withdrawals may not coincide with bank compounding periods. In that case, adjust the interest rate so it will be equal to payment period.

Example - Monthly payments and daily compounding

You make monthly deposits of $25.00 in a saving account paying 5% compounded daily based on a 365 days a year. How much money will you earn after 7 years?

First Step - Calculation of rate equal to monthly compounded.

Commands	Display	Remarks:
5 [F] [NI] (position 6,3)	5.00	Enters nominal interest rate.
365 [F] [P/Y] (position 6,1)	365.00	Enters number of compounded bank periods per year.
[F] [EI] (position 7,3)	5.13	Calculates and displays the effective interest rate.
12 [F] [P/Y] (position 6,1)	12.00	Enters number of instalments per year.
[F] [NI] (position 6,3)	5.01	Calculates the nominal equivalent percentage compounded monthly.

Second Step - Calculation of the future value. You must set the calculator in mode beginning of period.

Commands	**Display**	**Remarks**
[F][BEG/END](position 7,2)	5.01	Sets the calculator in mode beginning of period.
0 [F] [PV] (position 5,2)	0.00	Enters present value.
25[+/-][F][PMT](pos.7,1)	-25.00	Enters instalment.
7 [X] 12 [=] (position 7,4)	84.00	Calculates the total number of periods.
[F] [N] (position 5,1)	84.00	Enters the total number of periods.
[F] [FV] (position 6,2)	2519.61	Calculates and displays the credit balance after 7 years: the future value.

Statistical mode

Configuration

To configure your calculator in statistical mode, enter the following sequence:

[2] [F] [Config] [5].

The statistical mode introduces a one and two dimensional statistic treatment which allows the calculation of the mean, standard deviation of a sample and of a population(*), linear regression (least squares method) and its correlation coefficient on paired elements representing abscissa value (X) and ordinate value (Y).

(*) The standard deviation of a sample assume that the data are extract from a larger set of values. The standard deviation of a population assume that the data represent a complete set of values.

Special memories

As mentioned before, the extended version of the calculator contains 30 memories. In the statistical mode, to allow the user to perform complex computations, 5 memories (#00 to #05) are reserved for the storage of statistics during calculations in progress.

Memory	Content
00	Number of elements N
01	Σ Xi
02	Σ Yi
03	Σ Xi^2
04	Σ Yi^2
05	Σ XiYi

Important: before executing any statistical computations, these memories should be set to zero. Clearing these memories can be accomplished with [F] [Clr all] function (position 2,4). Nevertheless, this function does not modify the storage of the other memories. To erase all memories, execute the following sequence:[F][Clr mem] (position 1,4).

One dimensional statistics

Entering data (one dimension)

One key is used to enter data, its :

[Σ] (position 3,3).

The general procedure of entering data is as follows:

enter the first value and press [Σ] (position 3,3);
subsequent values are entered in the same manner.

Correcting data (one dimension)

When an error occurs, you must remove the value by reentering the erroneous value in the same manner followed by the [-] function (position 5,4). Example:

Commands	Display	Remarks
[53] [Σ] (position 3,3)	53.00	Erroneous data;
[53] [Σ] (position 3,3)	53.00	Reenters data to be removed;
[-] (position 5,4)	53.00	Removes data and readjusts number of elements "n".

Note that this correction can be made any time while entering data.

Statistical functions (one dimension)

The following sections show one dimensional statistical functions available with the **AUDIOCALC** calculator:

[F] [Mean of X] (position 5,1)

$$\bar{X} = \frac{\sum X_i}{n}$$

[F] [Standard Deviation of the sample X] (position 5,2)

$$S_x = \sqrt{\frac{\sum X_i^2 - \frac{(\sum X_i)^2}{n}}{n-1}}$$

[F] [Standard Deviation of the population X] (position 5,3)

$$\sigma_x = \sqrt{\frac{\sum X_i^2 - \frac{(\sum X_i)^2}{n}}{n}}$$

Example: one dimension

The following example shows the use of one dimensional statistical functions.

Calculate the various statistics for the following data:

Values:	4.5	4	2	3.25	3.5	3.75

Data between parentheses represent position of the key.

Commands	**Display**	**Remarks**
[F] [Clr all] (2,4)	0.00	<- preparing to start statistical calculations
[4] [.] [5] [Σ] (3,3)	4.5	<- beginning of entering values
[4] [Σ] (3,3)	4.00	
[2] [Σ] (3,3)	2.00	
[3] [.] [2] [5] [Σ] (3,3)	3.25	
[3] [.] [5] [Σ] (3,3)	3.50	
[3] [.] [7] [5] [Σ] (3,3)	3.75	
[Recall] (1,3) [0] [0]	6.00	<- number of elements "n"
[F] [Repeat] (1,1)	6.00	<- pronounce number of elements "n"
[F] [Mean of X] (5,1)	3.50	<- Mean of X
[F] [Standard Deviation of the sample X] (5,2)	0.85	<- Standard Deviation of the sample X
[F] [Standard Deviation of the population X] (5,3)	0.78	<- Standard Deviation of the population X

Two dimensional statistics

Entering data (two dimensions)

Two keys are used to register pairs of data points. They are:

[First value] (position 3,2) and [Σ] (position 3,3).

The general method of entering pairs of data points is as follows:

enter X value	[First value] (position 3,2) and;
enter Y value	[Σ] (position 3,3).

When the second portion of a data pair, (the Y value), is identical to the previous Y value, you can omit its entry. Example: Enter the X value and press directly on key [Σ] (position 3,3). The calculator will then use the Y value of the previous pair and will instantly apply it to the Y value of this new pair.

Correcting data (two dimensions)

When an error occurs and you have to make corrections to a pair of data points, you must remove both values of the pair of data points. Example:

Commands	**Display**	**Remarks**
[25] [First value] (position 3,2)	25.00	Erroneous data, continues and enters Y;
[53] [Σ] (position 3,3)	53.00	Completes the entry in progress;
[25] [First value] (position 3,2)	25.00	Reenters data X to be removed;
[53] [Σ] (position 3,3)	53.00	Reenters data Y to be removed;
[-] (position 5,4)	53.00	Removes pairs of data points and readjusts number of elements "n".

Note that this correction can be made any time while entering data.

Statistical functions (two dimensions)

The following sections show various two dimensional statistical computations available with the **AUDIOCALC** calculator:

[F] [Mean of X] (position 5,1)

$$\overline{X} = \frac{\sum X_i}{n}$$

[F] [Mean of Y] (position 6,1)

$$\overline{Y} = \frac{\sum Y_i}{n}$$

[F] [Standard Deviation of the sample X] (position 5,2)

$$S_x = \sqrt{\frac{\sum X_i^2 - \frac{(\sum X_i)^2}{n}}{n-1}}$$

[F] [Standard Deviation of the population X] (position 5,3)

$$\sigma_x = \sqrt{\frac{\sum X_i^2 - \frac{(\sum X_i)^2}{n}}{n}}$$

[F] [Standard Deviation of the sample Y] (position 6,2)

$$S_y = \sqrt{\frac{\sum Y_i^2 - \frac{(\sum Y_i)^2}{n}}{n-1}}$$

[F] [Standard Deviation of the population Y] (position 6,3)

$$\sigma_y = \sqrt{\frac{\sum Y_i^2 - \frac{(\sum Y_i)^2}{n}}{n}}$$

[F] [Intercept of regression line] (position 7,3)

$$b = \frac{(\sum X_1^2 \sum Y_i) - (\sum X_i \sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

[F] [Slope of regression line] (position 7,2)

$$m = \frac{n \sum X_i Y_i - \sum X_i \sum Y_i}{n \sum X_i^2 - (\sum X_i)^2}$$

[F] [Correlation coefficient] (position 7,1)

$$r = \frac{n \sum X_i Y_i - \sum X_i \sum Y_i}{\sqrt{(n \sum X_i^2 - (\sum X_i)^2)(n \sum Y_i^2 - (\sum Y_i)^2)}}$$

Example: two dimensions

The following example shows the use of two dimensional statistical functions.

Calculate the various statistics for the following pairs of values:

X value:	65	67	70	63	62	64	68
Y value:	68	68	68	66	66	65	69

Data between parentheses represent position of the key.

Commands	**Display**	**Remarks**
[F] [Clr all] (2,4)	0.00	<- preparing to start statistical calculations
[6] [5] [First value] (3,2)	65.00	<- beginning of entering values
[6] [8] [Σ] (3,3)	68.00	
[6] [7] [Σ] (3,3)	67.00	<- has the same Y than the previous pair
[7] [0] [Σ] (3,3)	70.00	<- same
[6] [3] [First value] (3,2)	63.00	
[6] [6] [Σ] (3,3)	66.00	

[6] [2] [Σ] (3,3)	62.00	<- has same Y than the previous pair
[6] [4] [First value] (3,2)	64.00	
[6] [5] [Σ] (3,3)	65.00	
[6] [8] [First value] (3,2)	68.00	
[6] [9] [Σ] (3,3)	69.00	
[RCL] (1,3) [0] [0]	7.00	<- number of elements n
[F] [Repeat] (1,1)	7.00	<- pronounce number of elements n
[F] [Mean of X] (5,1)	65.57	<- Mean of X
[F] [Mean of Y] (6,1)	67.14	<- Mean of Y
[F] [Standard Deviation of the sample X] (5,2)	2.88	<- Standard Deviation of the sample X
[F] [Standard Deviation of the population X] (5,3)	2.66	<- Standard Deviation of the population X
[F] [Standard Deviation of the sample Y] (6,2)	1.46	<- Standard Deviation of the sample Y
[F] [Standard Deviation of the population Y] (6,3)	1.36	<- Standard Deviation of the population Y
[F] [Correlation coefficient] (7,1)	0.77	<- Correlation coefficient

[F] [Intercept of regression line] (7,3)	41.52	<- Intercept of regression line
[F] [Slope] (7,2)	0.39	<- Slope

Factorial computation

Factorial function [n !]

Example: to obtains the result of 5 factorial (5 !), you must press the following keys:

Commands	**Display**	**Remarks**
[5] [F] [n!] (position 7,4)	120.00	Calculates and displays the result.